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IOT BASED SOLAR TRACKING AND MONITORING SYSTEM

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ABSTRACT

Our project aim is building solar tracking system that will be able to track the position of the sun and align itself with the sun in order to minimize the angle of incidence of the incoming sunlight. The system will be built using Light sensors, Arduino UNO, microcontroller programmed in MATLAB and DC motor operated by microcontroller and external power source. Also we added monitoring system in that we can see voltage, current, humidity and temperature rating on LCD display as well as on our mobile using IOT module. The system was fixed on rooftop which is having an unobstructed view of sunlight and the motion of panel was noticed all over day. We can use wiper and spray of water for cleaning of panel surface and increase the efficiency of system. The power generated in system was used for various purposes. Eg. Street lamp, emergency lighting system in apartment, hospitals and complete power system for large scale industrial and commercial system.

Keywords: Arduino UNO, solar panel, IOT module, Motor driver, Battery, Sensors.

I. INTRODUCTION

In today's ever increasing population and never ending demands for energy, we are on the verge of running out of resources, if not now, then in coming 50 years. There is a need of greener source of energy is getting higher and higher. Solar power provides the way to extract the energy from sun light while keeping in mind the concept of preserving the environment. With efficient generation of energy from the sun and the proper usage of the energy generated, we expect to have a greener source of energy with higher efficiency.

Energy is a quintessential part of human life. The demand of energy is increasing day by day. Now a days we are using non renewable resources for generation of power but these are limited resource so we think about alternate option like solar, wind, tides, and geothermal heat. Solar radiation coming from atmosphere to earth is 174 petawatts (PW) and we didn't use fraction of it to generation of energy. But we cannot utilize it more than a fraction of the total. In photovoltaic systems, trackers help to reduce the angle of incidence (the angle that a ray of light makes with a line perpendicular to the surface) between the incoming light and the panel, which increases the production of energy the installation produces. Solar panels absorb sunlight and convert it into electricity that we can use. Sun will send 42 trillion kilocalories of energy per second to earth. In that huge amount of energy if we convert all 100% of energy into electricity then we create entire planets one year power in one hour. In all renewable sources solar energy is most powerful source. But solar energy doesn't give maximum efficiency. Use of tracking system can be increase amount of energy production with same panel. Basically it will track the sun and make sure that face of panel will perpendicular to the sun.

II. METHODOLOGY

The main impulsion is to design a high quality solar tracker. This paper consists of two parts hardware and software. It mainly having three parts input, controller and output. A light dependent register (LDR) is operates when light is fall on surface of LDR and resistance of LDR will increase. The resistance of LDR is normally high up to 1000000 ohm but when it comes in contact with light its resistance drops dramatically. LDR is having very low cost and simple construction. In DC motor there is two magnetic poles which is produces magnetic flux. Coil produces torque in armature when voltage applied to coil. DC stepper motor is used for panel rotation. To drive DC motor L293D IC is used as motor driver. Motor driver is used to achieve required speed to rotate panel. DC motor will move clockwise and anticlockwise depend on signal given by Arduino. The signal given by Arduino is depends on difference of light intensity on LDR our main aim to track sun movement is done by using LDR. Two LDR's are connected to Arduino analog pin AO and A1 that acts as the input for the system. The built-in Analog-to-Digital Converter will convert the analog value of LDR and convert it into digital. The input signal are given from LDR which is in analog value then Arduino is act like controller and the rotation of DC motor is output. We are design a single axis tracking system so we use LDR in pair of two. The illumination of

light is more on one LDR then difference will occur on node voltage send to Arduino and the necessary action will taken by Arduino.

The algorithm of the program is given as steps in the following.

Step 1.Read all analog voltages from analog channels

Step 2.If all voltages are equal then motor will be in stop position.

Step 3.If LDR1>LDR2 Then the top motor will rotate clockwise.

Step 4.If LDR1<LDR2 Then the motor will rotate Anticlockwise.

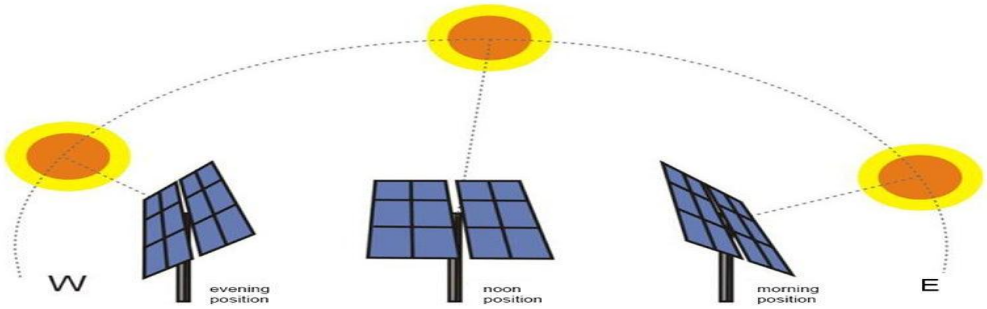

Fig.1 Rotation of panel with sun direction

III. MODELING AND ANALYSIS

BL0CK DIAGRAM

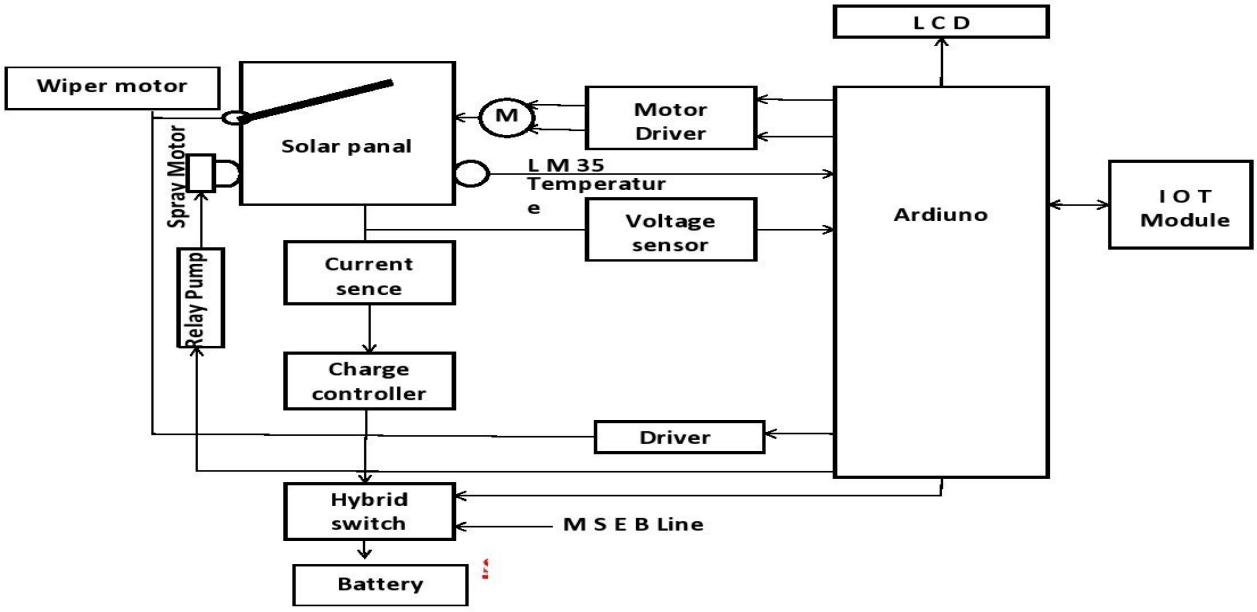

Fig.2 Block diagram

Block diagram and circuit diagram of solar tracking and monitoring system as shown in above figure. The system contain components are Arduino, LDR, charge controller, steeper motor, battery, solar panel. It works as per shown in block diagram.

Generally, solar panels are stationary and do not follow the movement of the sun. tracker will track sun and make panel perpendicular with sun to gain maximum sunlight. And we maximize generation of electricity by getting overcome the angle between radiation and panel. Also we use IOT system to display monitored values of voltage, current, temperature and humidity on our mobile these values also displayed on LCD screen placed near to structure. We can use another way to maximize production of energy by washing a panel by use of spray and clean using wiper. A charge controller is used here to maintain a constant supply to battery and give protection to battery against over voltage we use relay. Hybrid switch is use to switch supply on battery to MSEB.

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SIMULATION DESIGN

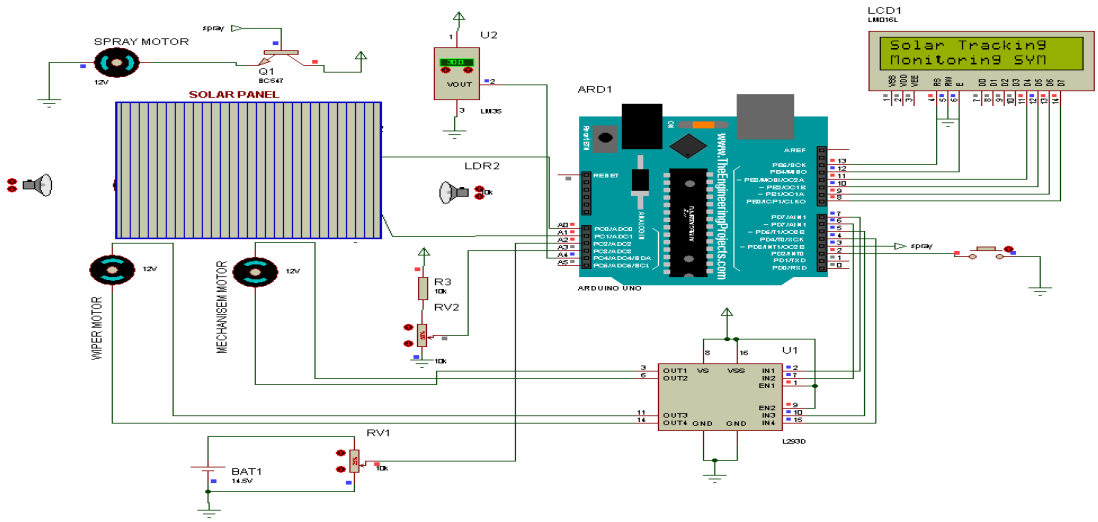

Fig.3 Simulation diagram

As shown in fig. solar tracking system consist of sensor circuit ,display circuit and motor driver circuit .the Arduino UNO is a heart of the project all the decision making action done by this Arduino as per preprogrammed. In our project we use 3 motors, for rotation of solar panel and another two motors are used to wiper and spraying purpose. For driving of these motors we need a driver circuit. We have use L293D and BC547 transistor for driving purpose. For measurement of temperature we have used LM35 temperature it can sense the panel temperature.

For sensing of voltage and current we use a voltage divider network for calibration of higher voltage to lower as we require Arduino for sensing and display purpose. For spraying push button is used to operate on and off and wiper is also operate on same button. By using this button motor will rotate only one cycle.

ACTUAL DESIGN

Fig.4 Actual design

COMPONENT DETAILS

1 Battery

This is an important block why because all the components require power supply to be operating. In our project 12 v 7Ah battery is used. There is only one battery used. The Arduino requires +7v, DC Motors require +12v in spraying motor 5v supply used and voltage regulator is use to maintain constant voltage supply to

Arduino. System will require maximum 12 v and we use 12 v batteries to operate relay and give protection to battery against over voltage.

Fig. 5 Battery

2 Solar panel

The term solar panel is used colloquially for a photo-voltaic (PV) module. Photo-voltaic cells use sunlight as a energy source and generate direct current electricity. In this system we use 18 watt solar panel. The panel is set on a structure as per design and spray and wiper is mounting on panel. Electricity generate form panel is send to battery for storage and other operation is done using battery power.

Fig. 6 solar panel

3 DC motor and Spray motor

When LDR sense heat and panel starts to rotate so motor move in steps that's why stepper motor is useful in the system. Stepper motor is divides a full rotation in to number of equal steps so we can rotate a motor at any speed and stop at any point which we want to stop.

Spray motor is used to pump and spray water on panel for cleaning of panel. The program set in Arduino UNO for spray is to operate motor twice in a day along with wiper.

Fig.7 DC stepper motor

Fig. 8 Spray motor

4 Arduino UNO

Arduino UNO is a microcontroller chip which is having a ATmega328P microcontroller made by Arduino. The system is operated by Arduino that's why it's called heart of system. Motors used in operation and IOT system for data collection both are operated on instruction of Arduino.

Fig. 9 Arduino UNO

IV. RESULTS AND DISCUSSION

Test Conducted for Output Power on various conditions.

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Test Conducted on Date:- 20-4-2021

Table no. 1

Sr. no.	Time	Position of Panel	PV Voltage	PV Current	Output Power
1	7am	-65	8	0.1	0.8
2	8am	-61	8	0.2	1.6
3	9am	-55	9.5	0.5	4.75
4	10am	-43	10	0.8	8
5	11am	-21	12.5	1.1	13.75
6	12am	-4	13.5	1.2	16.2
7	12.30pm	6	13.8	1.2	16.56
8	1pm	12	13.8	1.2	16.56
9	2pm	27	13.8	1.2	16.56
10	3pm	34	13.7	1.2	16.44
11	4pm	40	13.7	1.2	16.44
12	5pm	48	12.7	1.1	13.97
13	6pm	69	11	0.8	8.8
14	7pm	71	6	0.2	1.2

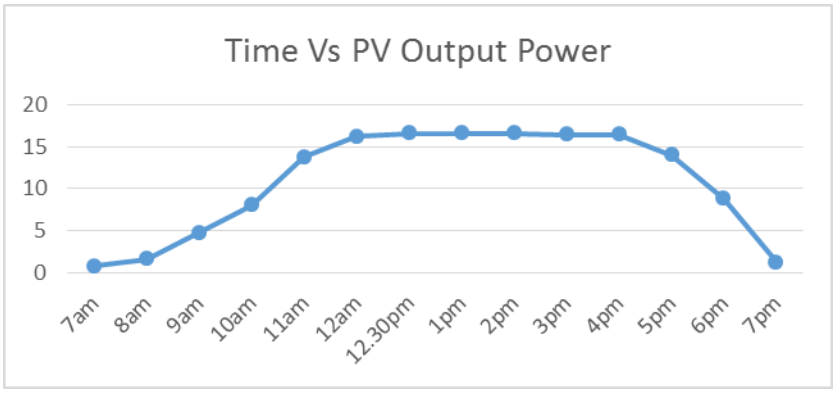

Fig. 10 Time vs PV

For taking result of on load system we conducted a test on a day 20-4-2021. On that day from 7 am to 7pm we take a reading of voltage and current for various position of panel and take the angles of the panel position. As shown in table from 11am to 5 pm production of power is on peak and before 11am and after 5 pm consumption efficiency is getting down.

V. CONCLUSION

The project is economical with smooth operation, quick response and user friendly. The concept of the project is to use more green energy to production of electric power and we use solar energy for this and we add tracking system so the efficiency of system will increase.

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